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EXAMINER

AHMED, SHAMIM

ART UNIT PAPER NUMBER

1765

DATE MAILED: 11/15/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/360,292

Applicant(s)

SHARAN ET AL.

Examiner

Shamim Ahmed

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 October 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 15-24 and 35-41 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 15-24 and 35-41 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 10/29/04 has been entered.

Response to Arguments

2. Applicant's arguments filed 10/29/04 have been fully considered but they are not persuasive. Applicants argue that Mathews et al (5,658,829) in view of Fukuyama et al (5,770,100) do not teach after removing the masking layer and subsequently utilizing an oxygen-comprising plasma to remove a residue from an outwardly exposed conductive silicon-comprising material.

In response, examiner states that it is true that Mathews et al do not explicitly teach the utilization of an oxygen plasma to remove residue from the exposed conductive silicon-comprising material (silicon substrate includes a dopant diffusion/active region, 14,38 in col1, lines 25-26 and col.3, lines 24-25) but this limitation would have been obvious during the oxygen etching of the masking layer because the active region is exposed to the oxygen plasma and expected to remove the remaining residue upon an over etching of the masking layer.

In general, the transposition of process steps or the splitting of one step into two, where the processes are substantially identical or equivalent in terms of function, manner and result, was held to be not patentably distinguish the processes. *Ex parte Rubin* 128 USPQ 440 (PTO BdPatApp 1959).

Further the argument is not persuasive because the primary reference (Mathews et al) teaches that etching a material to form an opening thereby extending the opening to outwardly expose a material comprising conductive silicon or active region (38) at the base of the opening (see the rejection and figures 4-5).

Examiner states that the secondary reference (Fukuyama et al) relied upon to show the general teaching of using oxygen-containing plasma in a post-etching of a silicon-comprising substrate in order to provide a cleaner surface for subsequent process (see the rejection)

In conclusion, Mathews et al in view of Fukuyama et al teach the claimed limitation of forming an opening thereby extending the opening to outwardly expose a conductive silicon-comprising material at the base of the opening.

3. Applicant's arguments with respect to claims 15-24 and 35-41 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Art Unit: 1765

5. Claims 35-41 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.
6. Claim 35 recites the limitation "the silicon-comprising" in lines 11-12. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

9. Claims 15-18, 20 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mathews et al (5,658,829) in view of Fukuyama et al (5,770,100).

Mathews et al disclose a method of forming a contact to a silicon substrate (36), wherein a contact opening is formed by etching an insulating layer (40) through a patterned/masked layer (42) over the silicon substrate and the etching extending the opening to expose outwardly a conductive silicon-comprising material as an active region (38) at the base of the opening (col3, lines 21-40 and figure 4).

Mathews et al also disclose that the masking layer is removed using oxygen etching/ashing after the etching process, which forms the contact opening (44) (col.3, lines 43-45 and figure 5).

Mathews et al teach that after removing the masking layer, conductive layer (52,54) is subsequently deposited (col.3, line 65-col.4, line 6 and figure 6).

Mathews et al fail to disclose the introduction of an oxygen-comprising plasma cleaning step to remove a residue from the outwardly exposed silicon-comprising material before the subsequently deposition.

However, it would have been obvious that the oxygen etching of the masking layer is capable to remove residual matters from the exposed active region of the silicon-comprising substrate because the active region is exposed to the oxygen plasma and expected to remove the remaining residue upon an over etching of the masking layer.

In general, the transposition of process steps or the splitting of one step into two, where the processes are substantially identical or equivalent in terms of function, manner and result, was held to be not patentably distinguish the processes. *Ex parte Rubin* 128 USPQ 440 (PTO BdPatApp 1959).

Additionally, in a post-etch treatment method, Fukuyama et al teach that the etched substrate is treated with oxygen-comprising plasma such as ozone (O_3), oxygen for removing residual matter (col.7, lines 7-24).

Therefore, it would have been obvious to one of ordinary skilled in the art at the time of claimed invention to combine Fukuyama et al's teaching into Mathews et al's process for efficiently removing the residual masking material as taught by Fukuyama et al.

By doing so, one could have a residue-free substrate that will assure the subsequent deposition process is contamination-free.

As to claims 17-18 and 20, Fukuyama et al teach that the plasma comprises hydrogen (H_2) (col.7, lines 10-24).

10. Claims 35 and 38-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mathews et al (5,658,829) in view of Fukuyama et al (5,770,100) as applied to claims 15-18,20 and 22 and further in view of Sharan et al (5,747,116).

Modified Mathews et al teach that the substrate is a bulk silicon substrate (col.3, lines 21-25) but remain silent about the bulk substrate is a monocrystalline silicon substrate.

However, Sharan et al disclose a method of forming a contact opening in a semiconductor wafer typically comprising a bulk monocrystalline silicon substrate, wherein a contact opening is formed over the silicon substrate and the opening is

Art Unit: 1765

extending to expose outwardly a monocrystalline silicon containing material (col.1, lines 24-31, col.3, lines 52-61 and figure 1).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of claimed invention to modify Mathews et al's bulk silicon substrate with Sharan et al's teaching of using a bulk monocrystalline silicon substrate as a typical silicon wafer substrate as a art recognized substitution for efficiently making electrical contact opening as taught by Sharan et al.

Additionally, Modified Mathews et al discussed above and Mathews et al also disclose that etching the material 40 comprises BPSG immediately beneath the masking material 42 of photoresist (col.3, lines 26-32).

Modified Mathews et al do not explicitly teach that the plasma etching for the carbon- containing polymer residue is substantially selectively relative to the BPSG layer and relative to the silicon-comprising layer.

However, Mathews et al teach that the etching of the BPSG layer is performed using carbon/fluorine based chemistry, it would have been obvious that the residue formed after etching is carbon-containing polymer (col.3, lines 38-40).

Additionally, Fukuyama et al teach that plasma etching is performed to remove selectively the carbon-containing resist residual material (col.7, lines 7-24), which reads on the limitation of plasma etching the carbon-containing polymer relative to the BPSG material and the silicon-comprising material because Fukuyama et al's post-etch treatment process is designed for efficiently removing the residual material.

As to claim 38, Fukuyama et al teach that the etched substrate is treated with oxygen-comprising plasma such as ozone (O_3), oxygen for removing residual matter (col.7, lines 7-24).

As to claims 39-40, Fukuyama et al teach that the plasma comprises hydrogen (H_2) (col.7, lines 10-24).

11. Claims 21 and 36-37 rejected under 35 U.S.C. 103(a) as being unpatentable over Mathews et al (5,658,829) in view of Fukuyama et al (5,770,100) as applied to claims 15-18,20,22 and in view of Sharan et al (5,747,116) as applied to claims 35,38-40 above, and further in view of Brown et al (5,780,359).

Modified Mathews et al discussed above in the paragraph 10 but fail to teach the temperature is at least 400 degree and at least 600 degree C.

However, in a method of removing polymer residue from the surface and sidewalls of a silicon wafer, Brown et al teach that the temperature of the stripping process can be varied from 20 degrees to over 100 degrees C, while the benefits of using higher temperatures includes a rate increase in the chemical portion of the stripping process (col.4, lines 26-33).

Therefore, it would have been obvious to one skill I the art at the time of claimed invention to optimize the process temperature to an elevated one because the elevated temperature will increase the rate of reaction of the stripping process as taught by Brown et al.

Art Unit: 1765

12. Claims 19 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mathews et al (5,658,829) in view of Fukuyama et al (5,770,100) as applied to claims 15-18,20,22 and in view of Sharan et al (5,747,116) as applied to claims 35,38-40 above, and further in view of Nagashima et al (5,129,958).

Modified Mathews et al discussed above in the paragraph 10 but fail to teach that the hydrogen comprising gas is NH_3 .

However, in a cleaning process for residue after fluorine plasma, Nagashima et al teach that both ammonia and hydrogen can be used as a reducing gas for efficiently cleaning the residue (col.2, lines 41-50).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to combine Nagashima et al's teaching into modified Mathews et al's method for efficiently removing the remnant resist material because both the ammonia (NH_3) and hydrogen gas are functionally equivalent as taught by Nagashima et al.

13. Claims 23-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mathews et al (5,658,829) in view of Fukuyama et al (5,770,100) and further in view of Chen et al (5,704,986).

Modified Mathews et al discussed above in the paragraph 9 but fail to teach the introduction of at least two plasma etching using different gas chemistries and specially the at least two plasma etching comprises first oxygen comprising and another is chlorine gas comprising.

However, Chen et al disclose a cleaning process for removing organic contaminant residue, wherein the cleaning process comprises:

A plasma comprises a first oxidant gas such as oxygen and subsequently supplying a gas comprises chlorine for enhancing the cleaning process by volatilizing the contaminants residue from the substrate to be cleaned, wherein the temperature is maintained below 800 degree C (col.4, lines 31-55, and col.6, lines 64-col.7, lines 45).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to combine Chen et al's teaching into modified Mathews et al's method for an improved cleaning process in order to efficiently removing the organic and metal contaminants from the substrate to be cleaned as taught by Chen et al.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shamim Ahmed whose telephone number is (571) 272-1457. The examiner can normally be reached on M-Thu (7:00-5:30) Every Friday Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Art Unit: 1765

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Shamim Ahmed
Examiner
Art Unit 1765

SA
November 9, 2004